Appendix E Calculation of Potential Water Savings at Resorts and Casinos

A simple end-use analysis by the Pacific Institute and Western Resource Advocates show that indoor water savings can be realized at hotels, casinos, and resorts. The analysis focused on lodging provided for overnight guests and does not take into account water used by day-trippers or other visitors who do not spend the night in a hotel or motel. We used 2004 as the base year for our analysis to estimate the number of overnight visitors, hotel and motel room stock, and the mix of old, inefficient fixtures and newer, more efficient fixtures mandated by federal law. While behavioral modifications can also produce savings during droughts or prolonged supply interruptions, our analysis only includes water savings that can be realized through the adoption of more water-efficient technologies.

Number of Overnight Guests

According to the Las Vegas Convention and Visitors Authority, there were 131,500 hotel rooms in Las Vegas with an occupancy rate of 89% in 2004, for a total of 116,500 occupied hotel rooms each day (Las Vegas Convention and Visitors Authority 2006). GLS Research further estimates that each room has an average of 2.1 guests (GLS Research 2006). Based on this information, we estimate that there are approximately 245,000 overnight guest-days per day, or 89 million overnight guest days per year.[1]

Faucets

The maximum flow rates for faucets are currently governed by national plumbing standards. Since 1994, new faucets sold or installed in the United States must use 2.5 gallons-per-minute (gpm) or less at a normal service pressure of 80 psi (EPAct 1992). Before such standards were enacted, faucet flow rates ranged from 2.75 to 7.0 gpm

[1] Note that this is higher than the estimated 40 million visitors in Las Vegas per year because guests stay 3.5 nights in Las Vegas, on average. Thus, there are approximately 140 million guest days per year. The difference between the number of hotel guests and the number of visitors represent daytrippers and those who stay with friends and family in the area.

(Gleick et al. 2003). While adequate data on the current variation in the presence of old and new devices in Las Vegas hotel rooms is not available, the Las Vegas Convention and Visitors Authority estimates that 33% of the existing room inventory for all resorts and casinos was constructed after these efficiency standards went into effect. In addition, older rooms have been renovated in recent years and likely have fixtures that meet current standards. Given the existence of both old and new hotel rooms, we conservatively estimate that the average faucet flow rate is 3 gpm.

A study by the Seattle Public Utilities Commission found that each hotel guest uses the faucet for an average of 3 minutes per day. Based on these assumptions, we estimated that the current daily faucet use is about 9 gallons per guest. Upgrading all old fixtures to the current national standard of 2.5 gpm would reduce daily faucet use to 7.5 gallons per guest, which would save 400 acre-feet per year (AFY). An even greater savings of 1,200 AFY could be achieved by installing inexpensive, widely-available faucet aerators that restrict the flow to 1.5 gpm.

Toilets

Toilet flush volumes have declined significantly over the past 25 years. Six gallon-per-flush (gpf) toilets were standard in commercial establishments built prior to 1980. Beginning in 1980, more efficient 3.5 gpf toilets became common, and in 1994, these toilets became required in all new commercial buildings. New plumbing standards implemented in 1997 require 1.6 gpf toilets in all new commercial establishments.

The current stock of toilets in hotels and casinos in Las Vegas is comprised of both efficient and inefficient models. Based on the changing history of plumbing standards, this analysis made the following assumptions:

- 6 gpf toilets were installed in all hotel rooms built prior to 1980;
- half of all hotel rooms built between 1980 and 1994 were equipped with 3.5 gpf toilets and the remaining half were equipped with 6 gpf toilets;
- 3.5 gpf toilets were installed in all hotel rooms built between 1994 and 1997;

- 1.6 gpf toilets were installed in all new hotel rooms built after 1997;
- Given an average toilet lifetime of 25 years, we estimated that each year after 1994 but before 1997, 4% of the 1994 toilet stock would have be converted to 3.5 gpf toilets. After 1997, 4% of the 1997 toilet stock would be converted to 1.6 gpf each year.

Based on these assumptions, we estimate that the average toilet in casinos and resorts in Las Vegas Valley uses 3.5 gpf.

Both the current water usage scenario and the efficient scenario assume that guests flush toilets an average of 4 times per occupied room per day and housekeepers flush an additional 2.6 times per occupied room per day while cleaning rooms (Brown and Caldwell Consultants 1990). Given an average occupancy of 2.1 guests per room (GLS Research 2006), the number of total flushes is equivalent to 3.1 flushes/guest·day.

Based on these assumptions, we estimate that toilets in Las Vegas hotel guest rooms use about 3,000 AFY. Replacing these toilets with more efficient 1.6 gpf toilets would reduce toilet water use by 54% to 1,400 AFY. Additional savings could be realized by installing widely-available toilets that exceed the current efficiency standards. The waterless urinal, for example, is increasingly common in commercial establishments and has proven its value, each saving on average 40,000 gallons per year in high-traffic areas. Although we did not calculate the potential savings of a program to install such fixtures in Las Vegas resorts and public areas, the potential is large.

Showers

Like toilets, the current stock of showerheads is a mix of efficient and inefficient models. Older showerheads are reported to have maximum flow rates ranging from 3–7 gpm (Vickers 2001), with an average rate of 5 gpm. Beginning in the early 1980s, showerheads with a 3.5 gpm average flow rate became available on the market. Driven by water conservation ordinances in a number of states and municipalities, the 3.5 gpm showerhead became increasingly prevalent (Vickers 2001). In 1994, the National Energy Policy Act of 1992 mandated the implementation of showerheads with a maximum flow of 2.5 gpm in all new buildings.

Due to the mix of efficient and inefficient showerheads in Las Vegas, the following assumptions were made:

- 5 gpm showerheads were installed in rooms built before 1980;
- hotel rooms built between 1980 and 1994 were equally likely to have the less efficient 5 gpm showerheads as the more efficient 3.5 gpm;
- all hotel rooms built after 1994 have 2.5 gpm showerheads;
- the average lifetime of a showerhead is 12.5 years, and beginning in 1994, the annual average replacement rate of older showerheads with those that meet current efficiency standards is 8%.

Based on these assumptions, we estimate that showerheads in Las Vegas hotel rooms have an average flow rate of 3 gpm. Under our efficient scenario, all showerheads are replaced with the current standard 2.5 gpm model. Further, studies indicate that showers are typically operated at about 66% of their maximum flow rate because people adjust the hot and cold taps but do not typically open both all the way (Mayer et al. 1999). To take this into account, we adjusted the rated flow of the showerheads by lowering the actual showerhead flow to 2.1 gpm and 1.5 gpm for the existing and efficient scenarios, respectively. Based on a survey of hotel customers prepared for the Los Angeles Department of Water and Power, we assume an average daily shower duration of 16.2 minutes per room (Brown and Caldwell Consultants 1990). Installing the most-efficient showerheads would reduce water use by 29%, or more than 1,300 AFY. Although not evaluated here, reductions in the amount of water used for showers also reduces energy costs.

Laundry

A 1990 study analyzed the laundry facility water use of 408 hotels throughout the U.S. that ranged in size from 251 to 2,033 rooms. The study found that water use by hotel laundries varied from 1.0 to 5.9 gallons of water per pound of laundry, with a median of 2.4 (Redlin and deRoos 1990). For our analysis, we assumed that the average hotel in the Las Vegas Valley used 2.4 gallons per pound of laundry. A 2004 Department of Energy Study found that new commercial units use an average of 34 gallons per load, while Energy Star qualified units use 20 gallons per load, a savings of 42% (U.S. EPA and U.S. DOE 2004). We estimate that installing more efficient clotheswashers could reduce water use to 1.4 gallons per pound of laundry.

A study by the Seattle Public Utilities Commission found that hotel guests generate 12 lbs of laundry per room per day (SPUC 2002). With an average occupancy of 2.1 guests per room, this is equivalent to 5.7 lbs of laundry per guest per day. Based on these assumptions, we estimate that current hotel laundry water use is 3,800 AFY. Installing more efficient washing machines could save an estimated 1,600 AFY. Additional water savings could be achieved by washing linens less frequently for multi-day guests. Although this approach has been taken by hotels throughout the country, including one in Las Vegas, in keeping with our emphasis on technological rather than behavioral changes, we did not include this option.

Cooling

Evaporative coolers and cooling towers are common components of air conditioning systems, and are especially effective in arid and semi-arid climates. Studies suggest that substantial improvements in the water-use efficiency of cooling towers are readily available. Replacing single-pass with recirculating cooling systems, for example, can reduce water use by up to 90% (Vickers 2001). A number of cities have passed ordinances requiring the use of water recirculation systems, including New York City, Denver, Phoenix, and Hawaii (Vickers 2001). For systems that are already recirculating water, increasing the concentration ratio through process control, pH and conductivity meters, or the use of anti-fouling chemicals can provide additional water savings. An analysis of six urban supermarkets in California concluded that most cooling units are "not operated to minimize their water use. On the contrary, most coolers are operated in a way that maximizes their water use in an effort to minimize the cost of water treatment" (Aquacraft 2003). The authors demonstrate that a well-run program to adjust water chemistry and increase recirculation can reduce water use by 50 percent. Sandia National Laboratories showed that upgrades to their 50 cooling towers saved 27.5 million gallons per year (Sandia National Laboratories n.d.).

We assumed that average cooling towers use 1.4 gallons of water per cooling degree day per guest (Redlin and deRoos 1990). According to the National Weather Service, the normal cooling degree days (CDD) from 1971-2000 varied from a low of 0 in the winter months to a high of 26 in July. We used the annual average CDD of 8.8 degrees per day. Given a 2004 visitor volume of 89 million overnight guest-days per year, we estimate that the current water use for cooling purposes in Las Vegas hotels is about 3,400 AFY.

Information on the current mix of cooling technologies in Las Vegas was not readily available. We follow Gleick et al. in conservatively estimating that water use for cooling could be reduced by 20% (Gleick et al. 2003), saving approximately 700 AFY.

Kitchens

Water is of prime importance to a well-functioning hotel kitchen: in cooking, dishwashing, rinsing, etc. We assume that hotel guests eat 2.2 meals per day, and that hotel kitchens use about 7.6 gallons of water per meal (Redlin and deRoos 1990). This amount is independent of water used in ice making, which is considered separately. In total, we estimate that hotel kitchen water demand in the Las Vegas Valley is about 4,600 AFY.

A number of water-efficient devices and practices, however, can save water in commercial and restaurant kitchens. For example, the California Urban Water Conservation Council (CUWCC) and participating water agencies recently installed nearly 17,000 restaurant pre-rinse spray valves in California and found that annual water savings were approximately 50,000 gallons per valve. Annual energy savings were also substantial, totaling more than 7,600 kWh and 330 therms for water heated by electric and gas heaters, respectively (CUWCC 2005). Given water and energy prices in Las Vegas, a single valve, which costs between $25 and $50, could save a business owner up to $800 annually on his or her utility bills from water, wastewater, and energy savings.[2] No comparable program is in place in Las Vegas. Other water-efficient devices include efficient dishwashers and manual-fill steamers. We have followed Gleick et al. (2003) in assuming that 20% water savings can be captured through kitchen equipment upgrades. This would result in water savings of nearly 700 AFY.

Icemakers

There is a great deal of variation in the amount of water use among different brands and models of icemakers. For example, inefficient water-cooled icemakers may use up to 160 gallons of water to produce 100 pounds of ice. Outdated air-cooled models reduce water use, but increase energy consumption; new, more energy-efficient air-cooled models use an estimated 20 gallons of water to produce 100 lb of ice and reduce energy consumption to levels comparable to water-cooled models (SFPUC 2007).

We followed Redlin and deRoos (2003) in estimating that hotel icemakers use 0.5 gallons per meal, and that the average hotel guest consumes 2.2 meals per day at his or her hotel. As it is not possible to know the mix of icemakers employed in every Las Vegas hotel, we conservatively estimate that a 20% water savings can be achieved by replacing outdated models with efficient ones. In the “Waste Not, Want Not” report, Gleick et al. (2003) report inefficient icemakers use 1.5, while efficient models use 1.2 gal/meal-day. Both of these estimates are significantly higher than the Redlin and deRoos, although the percent reduction (20%) is the same. A case study by the San Francisco Public Utilities Commission confirms that large savings are available by upgrading ice makers; in a case

[2] We assume that the combined water and sewer cost for commercial customers in Las Vegas is about $3.13 per thousand gallons. We assume that energy costs are $0.08 per kWh for commercial customers (Nevada and Power 2007) and $1.19 per therm (EIA 2007).

study of a large downtown hotel, switching from a water-cooled model to an efficient air-cooled model cut water use from 156 gallons to 20 gallons for 100 pounds of ice, saving over 200,000 gallons of water each year, or 0.6 AFY (SFPUC 2007).[3]

Summary

Our analysis reveals that substantial reductions in hotel water demand are possible using currently available technology. In Table E-1 and Figure E-1, we compare estimated hotel water demand by end use with an efficient water-use scenario. We estimated that the average daily indoor water demand can be reduced from 80 to 57 gallons per guest per day, a 29% savings. Given an estimated 26 million overnight guests in Las Vegas annually, the estimated reduction in diversions would be 6.3 KAFY. The greatest savings could be achieved by adopting current, proven, cost-effective technologies such as toilets and efficient clothes washers. Although not evaluated here, studies indicate that reducing water demand can also provide substantial energy savings, particularly for hot water appliances such as clothes washers and showerheads. Savings would be greater if we had included day-trippers, who eat at restaurants and use restrooms.

Table E-1 Estimated Water Demand at Las Vegas Hotels and Potential for Water Savings

	Current Water Demand (gal/guest-day)	Efficient Water Demand (gal/guest-day)	Current Water Demand (KAFY)	Efficient Water Demand (KAFY)	Savings (KAFY)	Savings (%)
Showers	16.2	11.6	4.4	3.2	0.3	29%
Faucets	9.0	7.5	2.5	2.1	0.4	17%
Toilets	10.9	5.0	3.0	1.4	1.6	54%
Laundry	13.7	8.0	3.8	2.2	1.6	42%
Kitchen	16.7	14.3	4.6	3.9	0.7	14%
Icemakers	1.1	0.9	0.3	0.2	0.1	20%
Cooling	12.3	9.9	3.4	2.7	0.7	20%
TOTAL	**80.0**	**57.1**	**21.9**	**15.7**	**6.3**	**29%**

Note: Total may not add up precisely due to rounding.

[3] Water savings may vary depending on system water pressure.

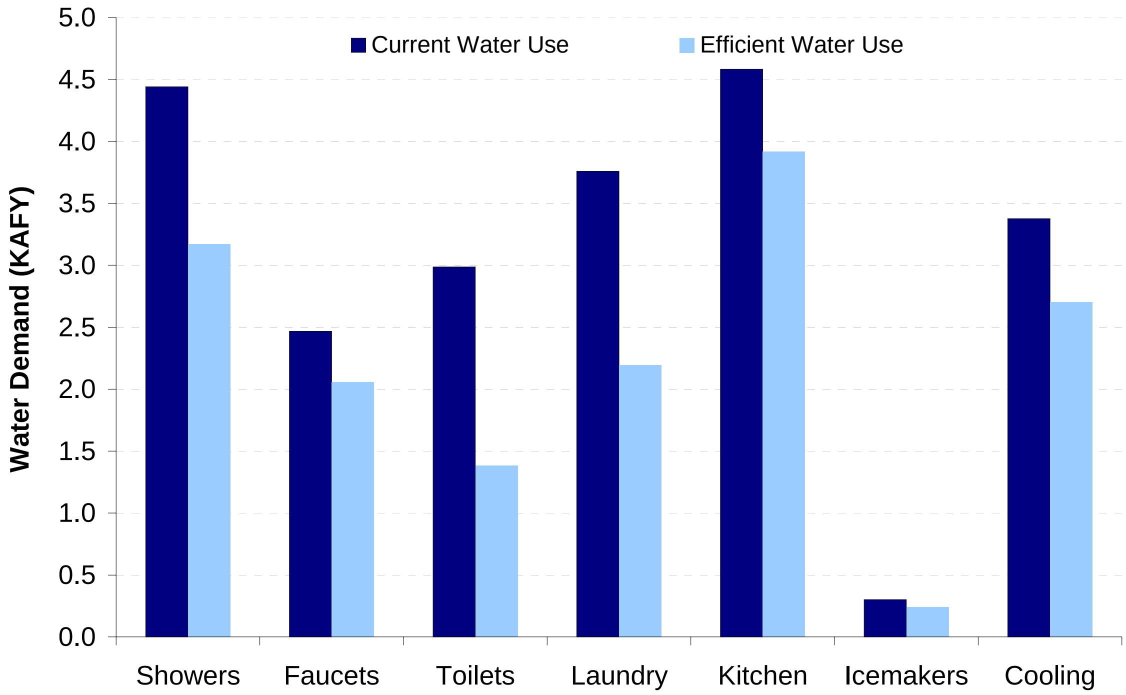

Figure E-1 Potential Annual Water Savings in Las Vegas Hotel Guest Rooms

Note: Of the end uses shown above, only cooling water represents consumptive use.

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